U.S. ARMY TECHNICAL CENTER FOR EXPLOSIVES SAFETY

EXPLOSIVES SAFETY

Volume 4, Issue 1 Savanna, Ill 61074-9639 December 1992

INSENSITIVE MUNITIONS

Led by the Navy's concerns regarding the catastrophic consequences of fires aboard aircraft carriers, all three services have implemented programs to make their ammunition less sensitive to common battlefield stimuli. Although main charge explosives used by the military are safe to handle and are not easily detonated, the loss of one will frequently cause all those in close proximity to detonate in sympathy. Making munitions less likely to explode in storage, whether they are stored in an aircraft carrier, a Bradley Fighting Vehicle, a train, or an igloo magazine, requires an integrated approach involving the explosive material, the munition design, its storage container, and testing to verify that the goal of greatly reduced sensitivity has been met.

The Army's Insensitive Munitions (IM) program is managed by the Army Insensitive Munitions Office (IMO) at the U.S. Army Armament Research, Development and Engineering Center (ARDEC). This organization is examining the threats a munition will face in the various phases of its life cycle and specifies tests to demonstrate its insensitivity to these threats. These tri-service tests include fuel fires (Fast Cook-Off), slow temperature rise until reaction (Slow Cook-Off), .50 caliber bullet impact, high speed fragments, shaped charge spall, shaped charge jet, and sympathetic detonation. To be considered insensitive, the item may burn in the first five tests and must not detonate in the last two.

The Army and Navy are each developing candidate explosives and propellants for use in an insensitive Hellfire missile system. These materials will be evaluated with respect to insensitivity, performance, cost, and producibility. Fabrication of the Hellfire missile using less sensitive explosives and propellants will provide increased safety for the users of the missile while keeping the same levels of mission performance.

The Air Force is currently testing a new explosive, AFX-770, which shows great promise for IM applications. Its insensitivity has been demonstrated by loading it into standard MK 82 bombs. These bombs have passed nearly all of the required tests, indicating the promise of AFX-770 for use in future ammunition which will be safer to handle and store in the battlefield environment, while still accomplishing the required mission and performance of the war item.

These examples illustrate the services' efforts and progress towards providing the soldier with safer ammunition.

by: Steve Blunk
Chemical Engineer
DSN: 585-8766

NAIL GUN ACCIDENT

On 9 September 1992, a less-than-truckload (LTL) shipment of M206 aircraft countermeasure flares was being blocked and braced prior to off-post transportation. Floor dunnage was being attached using a pneumatic nailer. During this operation, a 3 1/4" nail was inadvertently driven through the packing material and into at least one M206 flare. The ensuing fire resulted in the death of the employee and the loss of the trailer and its contents. A verification test conducted by the installation confirmed that, under the conditions present at the time of the accident, a nail driven by this pneumatic nailer would initiate an M206 flare in its DOT packaging.

The pneumatic nailer which was central to this accident was not authorized in the SOP for the operation. Its use in the operation had not been analyzed to assure that it would not represent a hazard. This accident underscores the responsibilities of management to assure:

- All equipment used in ammunition operations is analyzed for potential hazards.
- The operation is fully described by the SOP.
- Operators are trained in activities specified in the SOP.
- Operators are neither encouraged nor permitted to deviate from the SOP.

Operators have a complementary responsibility to:

- Follow the SOP explicitly.
- Never introduce unapproved tools or methods.
- Always exercise due care.

In an effort to preclude further incidents/accidents, one major Army command (MACOM) has banned the use of powered nailers around explosives. The nailers may be reintroduced to operations after identification of specific uses in which the powered nailers do not present a hazard.

by: Steve Blunk
Chemical Engineer
DSN: 585-8766

STEAM, WATER, AND AIR CONDITIONING LINES SERVING EXPLOSIVES BUILDINGS

For quite some time, explosives safety regulations have required all utility lines serving explosives buildings be buried the last 50 feet before entering the building. "Utility" lines include incoming power, communications, steam, water, and air conditioning lines. Unfortunately, the majority of our industrial base was built before this requirement came into effect. As a result, many utility lines run aboveground all the way to the building they serve. During surveys, the Department of Defense Explosives Safety Board (DDESB) Secretariat has cited many installations for having these aboveground lines.

At their 306th meeting, the DDESB granted a significant relaxation to these requirements: Some types of lines - steam, water, and air conditioning - may run aboveground to the explosives structure as long as they are bonded to the structure's lightning protection system (LPS) prior to entering the structure. The Army will incorporate this change into DAP 385-64, Ammunition and Explosives Safety Standards.

by: Clifford H. Doyle
Safety & Occupational Health Manager
DSN: 585-8741

JOINT SERVICE LARGE ROCKET MOTOR DISPOSAL PROGRAM

Through disarmament treaties and normal life cycle, a large number of large rocket motors (LRMs) are in the inventory awaiting disposal. To develop a DOD corporate solution for the safe, economical, and environmentally-acceptable disposal of LRMs, the Joint Ordnance Commanders Group (JOCG) established the Joint Service Large Rocket Motor Disposal Office (JSLRMDO) on 28 February 1992. The JSLRMDO is coordinating research and development (R&D) of seven technologies and studies for propellant removal, recycle/reuse, disposal, and waste stream treatment. Briefly summarized, these are:

a. Removal/Reclamation Technologies:

(1) Critical Fluid Removal/Reclamation (Army): This technology uses liquefied gases to remove the propellant by erosion and recovers the oxidizer and/or energetic materials by evaporating the liquefied gas.

(2) High Pressure Water Washout (Navy): A waterjet operating at 20,000 psi is used to remove propellant. Methodology to recover some materials is also under study.

(3) Cryogenic Dry Washout (Air Force): A cryogenic fluid, liquid nitrogen, is sprayed onto the propellant. Through a combination of low-temperature embrittlement and fluid shear, the propellant is eroded away from the rocket motor and recovered as a dry powder or particles. The dry propellant can then be reclaimed or destroyed.

b. Waste Stream Treatment Technologies:

(1) Biodegradation of Propellant (Air Force): A microorganism has been isolated which reduces propellant ingredients in waste streams. Further R&D effort is directed at optimizing the process and determining the mechanism of the bioreaction.

(2) Supercritical Water Oxidation (Air Force): This technology exploits the properties of water at temperatures and pressures above its critical point to rapidly oxidize propellant ingredients. Products of this reaction are carbon dioxide, water, nitrogen, and salts.

c. Disposal Technology: Contained Burn with Scrubber (Navy): After removal of the nozzles from the solid rocket motor, the motor is allowed to burn to completion in a combustion chamber. The combustion gases are contained and scrubbed in a series of quencher and scrubber systems to capture and remove particulates, hydrochloric acid, and organic contaminants.

d. Recycle/Reuse Technology: Characterization of Reclaimed Ammonium Perchlorate (AP) (Air Force): Extraction and recovery of AP from propellant washout slurry and waste scraps has been demonstrated. To recycle/reuse this AP, it must first undergo extensive laboratory analysis to verify its purity and then rigorous qualification testing of reformulations with virgin AP.

Completion of R&D phase for the above technologies is scheduled for FY 95.

by: Lew Kopera
QASAS
DSN: 585-8605

THE SAFELOAD EXPLOSIVES SAFETY PROGRAM (FORMERLY QUICKLOAD)

The Project Manager for Ammunition Logistics' (PMAMMOLOG) Safeload Explosives Safety Program provides solutions to reduce hazards and increase survivability throughout the ammunition logistics system. The program is to provide simple and cost-effective solutions to ammunition storage problems by developing new barriers, innovative ammunition storage techniques, and improving explosives safety technology.

To date, the program has produced nine technical data packages (TDPs) which are available from the U.S. Army Technical Center for Explosives Safety (USATCES). These include the 105mm Tank Ammunition Storage Rack; 8 Inch Trinitrotoluene (TNT) Artillery Pallet Barriers; 4.2 Inch Mortar Rack; Tube-Launched, Optically Tracked, Wire-Guided (TOW) Missile Rack; 105/120mm Tank Ammunition Rack; Agan Steel Panel (ASP) Wall; Sand Grid Wall; Improved 4.2 Inch Mortar Rack; and Mixed Loads in Container Express (CONEX) Containers. Three of these TDPs have just recently been approved by the DDESB and are available from USATCES:

a. Sand Grid Wall. The Sand Grid Wall allows truckloads of nearly all types of 155mm artillery ammunition to be stored with only a 15-foot separation. This is a substantial reduction from quantity distance (QD) regulations which would require 150 feet if unbarricaded and 82 feet with standard above ground barriers. The wall is placed between the trucks and prevents explosive propagation. This allows storage of up to 160 155mm projectiles and an equivalent number of propellant charges. Sand grid walls are inexpensive and can be built by unskilled labor.

b. 4.2 Inch Mortar Rack. The 4.2 Inch Mortar Rack provides safe storage of 48 high explosives (HE) mortar projectiles in a tactical environment. Use of the rack reduces the inhabited building distance (IBD) from 1,250 feet to only 100 feet, except at the door where 310 feet is required for a 30 degree arc. The result is a reduction in encumbered land required from 113 acres to only 1 acre. The simple wooden modules which compose the rack are made of common lumber. The modules are stacked inside a CONEX container and prevent round-to-round propagation. Plastic bottles with fire suppressive liquid are placed inside the modules. During an accident, the bottles rupture, coating all wood with a fire preventative which prevents cookoffs or secondary fires.

c. Mixed Loads in CONEX Containers. This TDP describes a method for storing up to 500 pounds of hazard class/division (HC/D) 1.1 bulk HE or demolition charge material. The IBD is reduced from 1,250 feet to only 360 feet. Certain small caliber ammunition, smoke grenades, ground illumination signals, and a file destroyer may also be stored. The solution also allows CONEX spacing to be reduced from 96 feet to only 8 feet. Although not required for the QD reductions, optional sand bag wall barricades may be built on three sides of the CONEX container with two layers of sandbags on the roof. In the event of a detonation, the sandbags reduce damage to adjacent CONEX containers. This TDP is intended for a tactical environment. In other environments, normal magazine storage applies. For any storage facility, a site submission is required.

Ongoing projects which will be completed in the near term include covered trench storage of uploaded artillery trucks; a risk analysis for ammunition storage during wartime operations; a guide for the construction of predesigned geosynthetic reinforced sand barricades; small inexpensive earth-covered magazines which provide QD reductions for 30-, 75-, 150- and 300-pound NEWs; and a project which will identify the "worst

case" propagation test donor and acceptor munitions so future Safeload tests will be valid for a wider range of munitions.

The program is designed to react to user needs and seeks to be informed of QD concerns for consideration as future Safeload projects. You are encouraged to relay your QD concerns and problems to: The Office of the Project Manager for Ammunition Logistics, ATTN: AMCPM-AL, Building 455, Picatinny Arsenal, NJ 07806-5000 and Director, U.S. Army Technical Center for Explosives Safety, ATTN: SMCAC-ESL, Savanna, IL 61074-9639. Approved TDPs are available from SMCAC-ESL.

by: Robert A. Rossi
Systems Engineer
PM-AMMOLOG
DSN: 880-2188

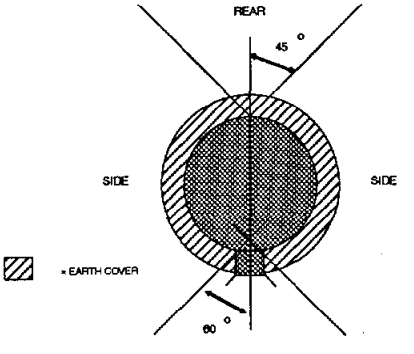
Clifford H. Doyle
Safety & Occupational
Health Manager
DSN: 585-8741

MAGAZINES

CORBETTA

Corbetta magazines present a special problem in determining what are the front, sides, and rear. A check with the Department of Defense Explosives Safety Board (DDESB) produced the following method:

To determine the front, draw a line perpendicular to the door through the center of the magazine. Extend this line through the magazine. From this line draw two lines, one either side of the centerline, which are 60 degrees from this centerline (a 120 degree arc) and going through the point where the exposed wall meets the earth cover. Anything within this arc is considered to be to the front of the magazine. To determine the rear, draw two lines from where the centerline bisects the rear wall. Each line should be at a 45 degree angle to the centerline and going away from the door. Anything within this arc is considered to be to the rear of the magazine. Whatever does not fall within these two arcs is considered to be to the side of the magazine.



CORBETTA MAGAZINE - FRONT, SIDE, AND REAR

Corbetta magazines, because of the manner in which they were constructed, are considered to be *nonstandard* magazines. The net explosive weight (NEW) limits for a front-to-front exposure in both magazines is limited to 20,000 pounds each. For all other exposures, the NEW is limited to 250,000 pounds. The only exception to this rule is magazines which have been strengthened in accordance with one of the U.S. Army Corps of Engineers (USACE), Huntsville Division, drawings #149-90-22, 149-90-23, or 149-90-24. Then the NEW is limited to 500,000 pounds when this fix has been applied and the magazines are at least 400 feet apart.

SERVICE

The designation of a facility as a service magazine is determined by use, not just location. A service magazine is used to hold explosives or ammunition that is to be used in an operation such as a maintenance, production, or surveillance operation. It can also be used for temporary holding of items which have been worked. The quantity distance (QD) that applies to the service magazine is intraline (IL) to the operation and only applies from the service magazine to the operation. This criteria is applied because it is the operation which is being protected, not the service magazine. The QD between service magazines for the same operation is magazine distance.

However, if this magazine is used to store items which are not related to the operation, such as storage for explosive ordnance disposal (EOD), a series of changes in the QD rules occur. The first is that the one-way QD, which applies to a service magazine, is no longer valid. The QD must now be figured from the operating building to the magazine, as well as from the magazine to the operating building. The second change is in the distance required. The operating building or the magazine may have its NEW capacity greatly reduced because of the need to use a greater distance, which in some instances may be inhabited building distance (IBD). The third is that the change in use now requires the submission of a site plan. As can be seen, a service magazine is best left as just that - a magazine that services an operation.

by: Gregory A. Magerl
Logistics Management Specialist
DSN: 585-8743

EXPLOSIVE SAFETY FOR FIRING RANGES COURSE

The Ammunition School at the U.S. Army Defense Ammunition Center and School (USADACS) has recently developed a 40-hour course entitled "Explosive Safety for Firing Ranges." This course provides information on the safe handling of explosives for firing ranges from issue to use.

Topics include an overview of explosives and propellants, ammunition packaging requirements, ammunition storage, explosive safety - quantity distance, ammunition transportation, range operations, and accident/malfunction reporting.

This course will be presented at USADACS on 26-30 April 1993 and 16-20 August 1993 and can also be presented on-site.

For additional course information, please contact Mr. John W. Gray, USADACS, DSN 585-8232.

by: John W. Gray
QASAS
DSN: 585-8232

DDESB SITE AND GENERAL CONSTRUCTION PLANS

A Site and General Construction Plan must be approved before design or construction can start on an explosives or inert structure within or near an explosives storage/maintenance area. The plan shows the siting of the proposed facility on a scaled map (sited at correct minimum safety distances from other facilities) and contains general construction details. Plans for fire and lightning protection, operational shields, barricades, and other construction features must be reviewed and approved.

The installation planning the construction must submit the plan to their MACOM, who approves the plan and forwards it to USATCES for Army review and approval. The USATCES then forwards the plan to the Department of the Army Explosives Safety Board (DDESB) who provides final approval.

The USATCES provides help to the installations in preparing the plans, making sure that each plan contains all the information needed to gain DDESB approval. This requires extensive coordination with both the MACOM and the installation.

In FY 92, USATCES received 76 Site Plans and completed 81.

DEPARTMENT OF THE ARMY
U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL
SAVANNA, ILLINOIS 61074-9639

BULK RATE
POSTAGE & FEES PAID
SAVANNA ARMY

POINTS OF CONTACT

The following are the office addresses and telephone numbers to notify when inter-service situations arise:

ARMY: *The Army has identified two locations. Either is acceptable for notification and proper coordination will follow a request.*

- Office of the Chief of Staff, U.S. Army, ATTN: DASC-SF, Washington DC 20310-0200, DSN: 225-7291/7294, commercial (703) 695-7291/7294
- Director, U.S. Army Technical Center for Explosives Safety, ATTN: SMCAC-ES, Savanna, Il 61074-9639, DSN 585-8919, commercial (815) 273-8919.

NAVY: *The Navy has identified two locations. The top address should be contacted for policy issues; the bottom address should be contacted for technical issues.*

- Chief of Naval Operations, ATTN: N411 (OP411), Washington, DC 20350, DSN 225-7094, commercial (703) 695-7094
- Commander, Naval Sea Systems Command, ATTN: SEA 665, Washington, DC 20362-5101, DSN 332-2080, commercial (703) 602-2080.

AIR FORCE:

- Headquarters, Air Force Safety Agency, ATTN: SEWV, Norton Air Force Base, CA 92409-7001, DSN 876-3137, commercial (714) 382-3137

MARINE CORPS:

- Marine Corps Systems Command, ATTN: AM, Washington, DC 20830, DSN 226-0924, commercial (703) 696-0924.

EXPLOSIVES ACCIDENT STATISTICS FY 92

TYPE	NUMBER	DAMAGE COST	INJURY COST	TOTAL COST
A	3	$513	$1,085	$1,598
B	3	$0	$361	$361
C	45	$0	$361	$361
TOTAL	51	$513	$1,807	$2,320

The above explosives accident statistics are a compilation retrieved from the Army Safety Management Information System (ASMIS) Retrieval and Processing System (ARPS) using the search criteria for explosives types. These FY 92 statistics represent explosives accidents reported to USASC on DA Form 285, U.S. Army Investigation Accident Report.

NOTE: The above amounts are in thousands of dollars.

The EXPLOSIVES SAFETY BULLETIN targets the ammunition/explosives community. It is printed in Savanna, Illinois.. If you wish to submit an article that is of interest to the ammunition/explosives community, or if you have a request for more copies of the bulletin, please forward it to: Director, U.S. Army Technical Center for Explosives Safety, Attn: SMCAC-ESM, Savanna, Il 61074-9639 or call us at DSN: 585-8745, commercial (815) 273- 8745